METHOD AND PROBE STRUCTURE FOR IMPLEMENTING A SINGLE PROBE LOCATION FOR MULTIPLE SIGNALS

Field of the Invention

The present invention relates to a method and probe structure for implementing multiple signals probing of a printed circuit board.

Description of the Related Art

In the testing of a printed circuit board, for example, during the initial bring up and debugging of system hardware, access to an area of interest on the printed circuit board for probing and/or connecting to signals often presents a problem.

Using a custom-designed flex cable to access mechanically constrained areas provides one possible solution to this problem. Flex cables are not integrated into the PCB, and need to be redesigned for each system packaging structure. Because custom flex cable designs are expensive, they represent a significant additional expense in addition to the procurement of the system PCB hardware.

Designers could also generally avoid this problem by designing mechanical accessibility for testing into the system. This can also be a costly alternative, as space is at a premium, both inside the system and in a customer's office.

U. S. patent 6,462,528 discloses a method and apparatus for probing

a terminal of a ball grid array device, or a conductor of an array of closely-spaced conductors, using a buried tip resistor located substantially adjacent to the point to be monitored. A relatively short stub is provided from the connection point to the tip resistor. A receiver amplifier arrangement substantially eliminates an offset error that is introduced into the signal to be measured due to variation in the resistance value of the tip resistor. The buried tip resistor is made small enough to fit within a BGA pad array, and buried within the layers of a circuit board material. The disclosed probing method and apparatus if applied for multiple signals would consume significant wiring channels in the PCB that typically would be needed for functional wiring.

With trends in the computer market moving towards smaller design spaces, designers are compacting more hardware into the mechanical areas around system boards. In some cases, the system is packaged in a way which precludes access to key electrical probe locations on the PCBs while the system is functioning. For example, the use of LGA attach methods can result in cards which are packaged parallel to each other with very little space in between. Blade servers are another example where space is at a premium and testability is difficult. In such cases it is required to find ways to probe critical signals without being able to place oscilloscope probes in close proximity to the desired probing location.

A need exists for an effective method and mechanism for implementing multiple signals probing of a printed circuit board.

Summary of the Invention

A principal object of the present invention is to provide a method and probe structure for implementing multiple signals probing in a printed circuit board. Other important objects of the present invention are to provide such method and probe structure for implementing multiple signals probing in a printed circuit board substantially without negative effect and that overcome many of the disadvantages of prior art arrangements.

In brief, a method and a probe structure are provided for implementing multiple signals probing of a printed circuit board. A probe

structure is formed on an outside surface of the printed circuit board. A resistor is electrically connected with an associated via with a signal to be monitored. A path to a predefined probe location for monitoring the signal is defined from the resistor using the probe structure.

Brief Description of the Drawings

The present invention together with the above and other objects and advantages may best be understood from the following detailed description of the preferred embodiments of the invention illustrated in the drawings, wherein:

FIG. 1 is plan view illustrating an exemplary probe structure in accordance with the preferred embodiment; and

FIG. 2 is plan view illustrating signal probing with the exemplary probe structure of FIG. 1 in accordance with the preferred embodiment.

Detailed Description of the Preferred Embodiments

Referring now to the drawings, in FIGS. 1 and 2 there is shown an exemplary probe structure generally designated by the reference character 100 for implementing multiple signals probing in accordance with the preferred embodiment.

In accordance with features of the preferred embodiment, a method is provided to allow the observation of many signals using a single probe structure 100 that is integral with a printed circuit board 102. Using an outside surface layer 104 of the printed circuit board 102, a predefined pattern or grid of a plurality of spaced apart stubs 106 that can be, for example, an etched copper pattern, forms the probe structure 100 within a selected area of the circuit board. Each stub 106 includes an elongated portion or wiring trace 108 having a selected length and typically extending between a pair of pads 110. A pattern or array of vias 112 in the printed circuit board 102 includes selected vias 112 connected to signals of interest. Probe structure 100 includes multiple pads 110 located near the vias 112 that are connected to signals of interest.

In accordance with features of the preferred embodiment, this probe structure 100 advantageously is used to bring out any desired signal by creating a path to a probe point 120 with a respective electrical short or zero-ohm resistor 122 placed between proximate pads 110 of selected adjacent stubs 106. A resistor 124 is placed on the surface 104 of the printed circuit board 102, near the signal of interest. A desired signal of interest is tapped using a particular associated via 112 through the inserted resistor 124 and trace wiring defined by the probe structure 100 together with the shorts 122 to the predefined probe point 120 on the printed circuit board 102. In FIG. 2, the associated via 112 of the desired signal of interest tapped by the inserted resistor 124 is shown in dotted line.

Using existing card manufacturing technology, probe structure 100 is etched onto the outside layer 104 of the printed circuit board 102. With an unpopulated backside of the board 102 carrying the etched traces 108 and pads 110 of the multiple stubs 106, the electrical short or zero-ohm resistor 122 is placed across the pads 110 to create a path for the desired signal to travel out of the area of the blockage, and to a predefined probing location 120. In this way, each signal is accessible for probing using the same probe point 120.

The signal swing at the probe point will be reduced proportionally according to the values of the PCB characteristic impedance and the value of the resistor 124 chosen, but key signal features will be available for evaluation. A high resistance value of the resistor 124 as compared with the card impedance results in a probe with which one can effectively monitor activity on the signal without excessive loading. With an impedance of the printed circuit board 102 of nominally 50 ohms, for example, a resistor value of 500 ohms would result in a voltage divider, with only 10% of the signal propagating on the probe line of the probe structure 100.

In accordance with features of the preferred embodiment, this probe structure 100 presents the tapped or monitored signal at a location 120 that is more easily accessible than the location of a particular associated via 112 of the monitored signal. This probing method will not result in extra stubs of wiring on the signal of interest because the resistor 122 is used to create the tap location. Thus, the resistor 122 can be populated for debug purposes,

and removed for shipping. Because probe structure 100 is integrated directly onto the printed circuit board 102, it utilizes the manufacturing processes already used to build the printed circuit board 102, and essentially no additional cost is incurred during the manufacture of the printed circuit board 102. The design of the probe structure 100 takes minimal effort during the computer aided design (CAD) layout phase of the PCB design.

It should be understood that the present invention is not limited to the illustrated embodiment. For example, one could insert more than one extraction point and probe location 120 onto the board 102, allowing the viewing of multiple signals from the area simultaneously.

While the present invention has been described with reference to the details of the embodiments of the invention shown in the drawing, these details are not intended to limit the scope of the invention as claimed in the appended claims.